Round Bale Silage Storage Losses of Ryegrass and Legume-Grass Forages

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Introduction

Round bale silage offers producers another option for harvesting and storing high quality forage. Even though the factors influencing silage quality are well documented, producers often harvest and wrap forages outside the limits considered acceptable for adequate fermentation and stable storage. This is especially true for moisture content, where the recommended range for successful ensiling is approximately 50 to 70% on a wet basis. Moisture contents below 50% are discouraged because of the increased likelihood of heating and respiration losses. The objective of this research was to measure silage quality and dry matter (DM) losses in round bale silages wrapped at moisture contents at and below recommended levels.

Methods

The study was carried out at four farms in eastern Oklahoma. First cutting forages (ryegrass or grass-clover mixtures) were harvested and ensiled. Grass ranged from late bloom to dough stage while clovers ranged from mid to late bloom. Bales were formed using a Vermeer Model 504I baler and were approximately 1.2 m in diameter and 1.2 m in width. At least 5 bales were made during three to four baling periods over two days at each location, giving a range of moisture contents. Bales were cored for analysis of moisture content and quality prior to wrapping. Bales were wrapped within two hours of being formed with white stretch film. At least six layers of film were used on each bale. Bales were weighed before being placed into storage on an exposed site at each location. Each bale was spaced at least 0.5 m apart from adjacent bales. After a minimum of six months storage, bales were weighed and cored at mid-height on each side. Samples were taken from the outer 10 cm and from 10 to 23 cm, representing approximately one third of bale volume. Samples were analyzed for moisture, pH, crude protein (CP), acid detergent fiber (ADF), neutral detergent fiber (NDF), total digestible nutrients and fermentation products.

Results and Discussion

Across the four locations, moisture content at ensiling varied from 25.3% to 69.1%, wet basis, and dry densities ranged from 101 to 203 kg/m^3. After at least six months of storage, average weight losses were small. For moisture contents above 50%, average weight losses for the four locations ranged from 0.8 to 2.0%. Lower weight losses were measured in the drier bales, 0.0 to 0.7%. Significant increases in CP and ADF occurred between the initial forage samples and final silages whereas NDF was unchanged except at the McAlester farm (Table 1). The relatively constant NDFs most likely were caused by the enzymatic breakdown of hemicellulose during ensiling offsetting the increase in concentration from DM losses. Changes in these quality parameters were not significantly affected by moisture content at any of the locations except for NDF at the McAlester farm. Assuming no loss or formation of CP and ADF in the bales, estimated DM losses across the four locations ranged from 5.6 to 9.1% and 2.4 to 11.7% based on CP and ADF contents, respectively. These estimated losses are low relative to those expected in traditional upright and bunker silos. However, our results are in agreement with those reported by other wrapped bale studies with various forages in other parts of the world.

Bale moisture content did affect fermentation. In general, silage pHs increased and lactic and acetic acid contents decreased with decreasing moisture content. Silage pHs tended to be higher and fermentation product levels lower than typically observed in silages from upright or bunker silos. Nevertheless, good preservation was observed in most bales. Only four bales

across the four locations had detectable levels of butyric acid, an indicator of poor fermentation, and none of these bales had butyric acid contents high enough to affect intake. Of the 312 samples analyzed, 18% had pH values above 6.5, indicating spoilage. Most of these samples were in the outer core samples. The proportion above pH 6.5 was relatively constant across samples having moisture contents less than 65%. Thus bales ensiled at moisture contents that would normally be considered too dry (< 50%) were apparently preserved as well as bales ensiled at recommended moistures (50 to 70%).

Conclusions

Grass and grass-legume silages made at low moisture content (< 50%) in wrapped round bales had similar changes in quality (CP, NDF, ADF) as silage made at higher, recommended moisture contents. Fermentation was reduced in low moisture bale silages, but spoilage and estimated DM losses were low and similar over a wide range of moisture contents. Consequently, the results of this study show that forages at moisture contents above that considered safe for dry storage (> 20%) but less than that acceptable for well-preserved silage (< 50%) can be preserved well in wrapped round bales provided that the integrity of the plastic film is maintained.

Table 1. Average bale quality at the four sites.

	CP (% DM)			ADF (% DM)			NDF (% DM)		
		Outer Layer, cm			Outer Layer, cm			Outer Layer, cm	
Location	Initial	0-10	10-23	Initial	0-10	10-23	Initial	0-10	10-23
McAlester	11.4	11.9	12.1*	39.6	41.3*	40.2	69.4	67.1*	65.7*
Hugo	13.5	14.8*	14.7*	36.7	42.6*	40.2*	60.9	62.1	59.1
Stillwater	11.8	13.3*	12.6*	37.5	40.1*	40.1*	55.5	55.2	55.1
Haskell	13.0	14.0*	13.6*	35.2	37.3*	37.3*	57.8	58.7	58.1

*Silage characteristic is significantly different ($P < 0.05$) from that in the initial forage.